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ABSTRACT

Designed to provide a background for the complex relationships between postsecondary education and its economic and technological context, this paper looks at economic conditions in the western United States, projections for economic and technological changes, and implications for community colleges. Following introductory material describing the ways in which postsecondary institutions respond to and contribute to economic development and change, the economic environment of the western United States is explored. Information is presented on personal income growth, employment patterns (1970-1984), unemployment rates, structures of the economies of the western states, and the occupational profile projected for the United States in 1990 as contrasted with that of 1980. In the next section, trends in employment in major industrial categories are examined, along with projections for employment changes in specific occupational categories, a discussion of technological developments and their effects on industry, and an analysis of the characteristics of high technology industries. Finally, a discussion is provided of the role of community colleges in the maintenance and expansion of local economies. (AYC)

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THE ECONOMIC AND TECHNOLOGICAL ENVIRONMENT OF COMMUNITY COLLEGES IN THE WEST

Materials developed for a legislative workshop on community college issues

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WICHE
Improving Education in The West
Western Interstate Commission for Higher Education
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DRAFT

THE ECONOMIC AND TECHNOLOGICAL ENVIRONMENT OF COMMUNITY COLLEGES IN THE WEST

Economic and technological changes affect postsecondary education in many ways. The condition of a state's economy affects the resources available to support education from public revenues and to pursue education from personal resources. Economic conditions influence enrollment patterns, since individuals take into account current and anticipated employment opportunities in making career and educational decisions. Economic and technological changes affect the scope and content of many postsecondary programs because of the need to make education and training relevant to a changing world. Finally, through the technological revolutions involving computers, telecommunications, and information systems, the methods of delivering education are being transformed.

These effects, however, do not flow in one direction only. Higher education itself is one of the primary social institutions helping to shape current and future economic conditions and to advance technological change. As a form of both public and private investment, education affects overall economic and social welfare as well as individual economic opportunity. Postsecondary programs not only respond to changing labor market conditions, but help to shape those conditions. Students not only enhance their individual capabilities, but society benefits through a more highly educated, effectively trained workforce. Perhaps most important, postsecondary education not only adapts to technological change, but contributes directly to the development, application, and understanding of those changes.

This chapter provides a background for these complex relationships by examining changes in the economic and technological environment of the western states. Variations in economic conditions within the WICHE states are

examined in the first section, since they have a direct bearing on the current and future operations of community colleges. Community colleges' heavy reliance on public funding underscores the importance of the health of a state's economy.

The second section looks at recent and anticipated employment changes by industry and state. These reflect not only overall economic growth but also those areas with exceptional employment and educational opportunities. Particular attention is given to the role of high-technology industries and the diffusion of new technologies throughout the economy.

The third section of this chapter suggests some of the broader implications of economic and technological change for community colleges. The issues raised include such direct effects as the impact of unemployment rates on enrollment patterns and underlying questions such as the type of education that will be most appropriate for the changing economic and technological environment of the western states.

Economic Conditions in the WICHE States

The 14 WICHE states have exhibited notable diversity in economic growth since 1970. The varying rates reflect underlying differences in industries and resources, the recent development of energy or new manufacturing industries, and related variations in population growth. Structural changes in the national and world economies from the dispersion of industries and the development of new products and technologies also have a significant impact on the western states, although the effects are uneven among and within the states. In addition to these factors, business cycles create short-term fluctuations in economic conditions. These conditions also vary among the WICHE states since periods of national recession and expansion affect specific industries and localities to different degrees.

Table II-1 shows total personal income growth in the WICHE states since 1970. The data, expressed in current dollar values, reflect monetary inflation as well as real growth resulting from business expansion and population increases. Notable economic trends indicated on this table include:

Table II-1

PERSONAL INCOME GROWTH IN THE WICHE STATES
1970-1983
(Current Dollars in Millions)

	1970	1980	1983	Percent Change 1970-1980	Percent Change 1980-1983
Alaska	$1,404	$5,238	$8,238	273.1%	57.3%
Arizona	6,507	24,179	31,575	385.2	30.6
California	89,312	261,964	333,741	193.3	27.4
Colorado	8,541	29,446	40,085	244.8	36.1
Hawaii	3,476	9,810	12,396	182.2	26.4
Idaho	2,352	7,678	9,450	226.4	23.1
Montana	2,438	6,576	8,124	169.7	23.5
Nevada	2,195	8,754	11,096	298.8	26.8
New Mexico	3,173	10,363	13,489	226.6	30.2
North Dakota	1,928	5,652	7,939	193.2	40.5
Oregon	7,765	24,553	28,585	216.2	16.4
Utah	3,451	11,292	14,555	227.2	28.9
Washington	13,730	42,541	52,368	209.8	23.1
Wyoming	1,268	5,228	6,126	312.3	17.2
WICHE States	$147,540	$453,274	$577,767	207.2%	27.5%
Non-WICHE States	$655,981	$1,703,436	$2,156,355	159.7%	26.6%

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, April 1974, p. 17, and August 1984, p. 42.

- For the WICHE region, the rate of growth in personal income during the 1970s was nearly one-third higher than in the remaining 36 states as a group--207.2 percent increase compared to 159.7 percent.

- This comparative regional advantage diminished in the early 1980s, a period that included a severe national recession that had a harsh impact on particular industries and states in the West. Personal income growth in the WICHE region was 27.5 percent between 1980 and 1983, compared to 26.6 percent for other states.

- Idaho, Montana, Oregon, Washington and Wyoming, which had grown rapidly during the 1970s, dropped to below average growth during the early 1980s.

- Growth in total personal income continued to be exceptionally high in Alaska, Colorado, and North Dakota, and higher than the regional average in Arizona, New Mexico, and Utah.

Table II-2 shows changes in per capita personal income since 1970. Compared to the nation as a whole, population changes appear to account for a substantial portion of personal income growth in several of the WICHE states. The economic expansion that accompanied population growth in many of the WICHE states during the 1970s, however, appears to have reversed in the early 1980s, at least in some areas. Significant changes that are apparent on Table II-2 include:

- Increases in per capita personal income between 1970 and 1980 exceeded the national average for 10 of the 14 WICHE states.

- Between 1980 and 1983, this ratio reversed when per capita income increases in 10 of the 14 states dropped below the national average.

- Despite these recent downturns in economic expansion, per capita income remains relatively high in most of the WICHE states. In eight WICHE states per capita income exceeded the national average in 1983, led by the largest state, California, where per capita income was 113 percent of the national average.

Economic growth is also indicated by expansion in employment. Table II-3 shows growth in total nonagricultural employment for the WICHE states for three periods since 1970. Several patterns are observable:

- The average annual percent growth in employment between 1970 and 1980 was significantly higher for every WICHE state than for the nation as a whole. Six of the western states had employment growth of more than twice the national average.

TABLE II-2

PER CAPITA PERSONAL INCOME IN THE WICHE STATES, 1970-1983

	1970	1980	1983	Percent Change 1970-1980	Percent Change 1980-1983	Percent of National Average 1983	Rank Among All States 1983
Alaska	$4,726	$13,007	$17,194	176.5%	31.6%	147%	1
Arizona	3,688	8,854	10,656	140.1	20.4	91	32
California	4,510	11,021	13,257	144.4	20.3	113	5
Colorado	3,887	10,143	12,770	160.9	25.9	109	8
Hawaii	4,674	10,129	12,114	116.7	19.6	104	15
Idaho	3,315	8,105	9,555	144.5	17.9	82	42
Montana	3,428	8,342	9,949	143.3	19.3	85	37
Nevada	4,691	10,348	12,451	131.3	14.8	107	10
New Mexico	3,072	7,940	9,640	158.5	21.4	82	41
North Dakota	3,216	8,642	11,666	168.7	35.0	100	21
Oregon	3,711	9,309	10,740	150.8	15.4	92	39
Utah	3,220	7,671	8,993	138.2	17.2	77	48
Washington	4,046	10,256	12,177	153.5	18.7	104	13
Wyoming	3,686	11,018	11,911	198.9	8.1	102	18
U.S. Total	$3,945	$ 9,494	$11,658	140.7%	22.8%	--	--

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Vol. 64, No. 8 (August 1984), p. 42; and U.S. Bureau of the Census, Statistical Abstract of the United States: 1984, 14th edition. Washington, D.C. U.S. Department of Commerce, 1983.

Table II-3

GROWTH IN NONAGRICULTURAL EMPLOYMENT IN WICHE STATES
1970-1984

	1970-1980 Average Annual Percent Change	1979-1982 Average Annual Percent Change	1983-1984 Percent Change
Alaska	6.2%	6.1	5.6
Arizona	6.4	1.7	10.9
California	3.6	0.6	6.3
Colorado	5.2	2.5	4.7
Hawaii	3.3	0.6	2.3
Idaho	4.7	-2.6	2.7
Montana	3.5	-1.4	4.1
Nevada	7.0	1.9	5.5
New Mexico	4.8	0.9	5.2
North Dakota	4.1	0.9	1.3
Oregon	3.9	-3.1	4.2
Utah	4.4	0.7	6.2
Washington	4.1	-0.3	3.9
Wyoming	6.9	2.7	-2.2
U.S. Total	2.4	-0.1	4.5

Sources: Richard J. Rosen, "Regional Variations in Employment and Unemployment during 1970-1982," Monthly Labor Review (February 1984), pp. 38-45; U.S. Department of Labor Statistics, Supplement to Employment Hours and Earnings, States and Areas (August 1984), Supplement to Employment and Earnings (July 1984), and unpublished Labstat Series Report, April 2, 1985.

- Employment growth slowed and became more uneven in the West between 1979 and 1982. Idaho, Montana, Oregon, and Washington experienced a decrease in nonagricultural employment during this period, and were below the national average.

- In the most recent period, 1983 through 1984, employment growth returned to all of the WICHE states except Wyoming, which experienced a 2.2 percent decrease primarily because of the effects of declines in the extractive industries. Employment growth in six of the other WICHE states was below the national average.

- Arizona, and to a lesser extent California and Utah, exceeded the average national growth in employment by a substantial margin during the most recent period.

If data for the more recent years are indicative of trends through the 1980s, employment growth in most of the western states will be slower than in the 1970s.

Unemployment rates have fallen in all WICHE states as the nation continues to recover from the recession of the early 1980s. The recession was severe in most of the western states, and the recovery has not been rapid in many. As indicated on Table II-4:

- During 1983, unemployment exceeded 10 percent in four WICHE states and was higher than the national average in seven of the fourteen states.

- In 1984, unemployment in five WICHE states still exceeded the national average.

- The unemployment rate decreased in all WICHE states between 1983 and 1984, but in only four states was this decrease greater than the national average.

Unemployment (that is, the lack of employment opportunities) remains a serious problem in at least half of the WICHE states in the mid 1980s.

Both long-term trends and more immediate economic conditions are related to the industrial, commercial and service components of a state's economy. Table II-5 shows the percentage of total nonagricultural employment in the eight major industrial categories in each of the WICHE states during 1984. As indicated by these percentages, the structures of the western state economies vary significantly, particularly with respect to employment in mining and manufacturing.

TABLE II-4

UNEMPLOYMENT RATES IN THE WICHE STATES,
1983 and 1984

	1983	1984	Change
Alaska	10.3	10.0	-0.3
Arizona	9.1	5.0	-4.1
California	9.7	7.8	-1.9
Colorado	6.6	5.6	-1.0
Hawaii	6.5	5.6	-0.9
Idaho	9.8	7.2	-2.6
Montana	8.8	7.4	-1.4
Nevada	9.8	7.8	-2.0
New Mexico	10.1	7.5	-2.6
North Dakota	5.6	5.1	-0.5
Oregon	10.8	9.4	-1.4
Utah	9.2	6.5	-2.7
Washington	11.2	9.5	-1.7
Wyoming	8.4	6.3	-2.1
U.S. Average	9.6	7.5	-2.1

Source: U.S. Bureau of Labor Statistics data taken from Oregon Department of Human Resources, Oregon Labor Trends (Salem, OR., March 1985), p.6.

TABLE II-5

PERCENT OF NONAGRICULTURAL EMPLOYMENT IN MAJOR INDUSTRIAL CATEGORIES
IN THE WICHE STATES, 1984

	Mining	Construction	Manufacturing	Transportation, Communications, Utilities	Trade	Finance Insurance Real Estate	Services	Government
Alaska	3.9%	8.9%	5.0%	8.4%	19.8%	5.5%	19.2%	29.3%
Arizona	1.1	8.1	14.6	5.1	24.3	6.1	23.2	17.5
California	0.5	4.2	19.4	5.2	23.8	6.6	23.9	16.4
Colorado	2.6	6.4	13.9	6.2	24.6	6.7	22.0	17.6
Hawaii	0	3.9	5.3	7.7	26.8	7.7	26.3	22.2
Idaho	1.2	3.9	16.7	5.8	25.3	7.2	18.9	20.9
Montana	2.7	4.5	7.9	7.3	27.2	4.8	21.3	24.3
Nevada	1.5	5.2	4.9	5.8	20.1	4.7	43.9	13.8
New Mexico	4.2	7.2	7.3	5.9	23.4	4.9	21.3	25.8
North Dakota	2.9	5.6	6.1	6.5	26.8	4.8	22.8	24.5
Oregon	0.2	3.0	19.8	5.6	25.1	6.5	20.4	19.4
Utah	2.1	5.8	15.7	6.0	23.4	5.0	20.2	21.8
Washington	0.1	4.7	17.4	5.5	24.6	5.8	21.[illegible]	20.7
Wyoming	13.7	6.5	4.2	8.0	22.5	4.0	16.2	25.0
WICHE States	1.0%	4.8%	16.7%	5.6%	24.0%	6.3%	23.4%	18.1%
U.S. Total	1.1%	4.6%	20.8%	5.5%	23.1%	6.0%	21.9%	17.0%

Source: United States Department of Labor, Bureau of Labor Statistics, unpublished Labstat Series Report, April 2, 1985.

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Reflecting the development of mineral and energy resources, mining employment is high in Alaska, New Mexico, and Wyoming and well above the national average in four additional western states. Demand and price fluctuations for these natural resources can have a severe impact on employment and the general economy in these states. Rapid economic growth in Alaska and Wyoming during the 1970s, for example, was fueled by the higher prices and demand for energy resources. Downward pressure on demand and prices in recent years has lowered employment and state revenues.

Employment in construction is heavily dependent upon growth in the general economy and on interest rates and other variables. Reflecting these factors, construction employment varied from a high of 8.9 percent of total employment in Alaska to 3.0 percent in Oregon during 1984. In nine WICHE states construction employment exceeded the national average of 4.6 percent.

Manufacturing employment showed large variations among the WICHE states and between the region and the nation. Employment in manufacturing is only about 5 to 6 percent of total nonagricultural employment in Alaska, Hawaii, Nevada, North Dakota, and Wyoming. Oregon (19.8 percent), California (19.4 percent), Washington (17.4 percent), and Idaho (16.7 percent) have the highest proportion of employment in manufacturing in the West. All are less than the national average of 20.8 percent. Clearly, the relative prosperity of the West as a region is not related historically to the proportion of total manufacturing employment.

The proportions of employment in the categories of transportation, communications and utilities; trade; and finance, insurance and real estate do not vary as significantly among the WICHE states or in comparison with the national average. Employment in the services sector does vary, generally in relation to such factors as the extent of the tourist industry (43.9 percent of nonagricultural employment in Nevada is in the service sector) and the degree of urbanization. Government employment, which includes teachers at public schools, colleges, and universities, also varies substantially in relation to the proportion of school-age population, the extent of federal

TABLE II-6

PROJECTED EMPLOYMENT CHANGE BY SECTOR IN THE 1980s
AVERAGE ANNUAL PERCENT CHANGE

	Mining	Construction	Manufacturing	Transportation, Communications, Utilities	Trade	Finance Insurance Real Estate	Services	Government	Total Wage and Salary Employment
Alaska	2.8%	6.0%	-1.2%	2.0%	6.5%	4.6%	5.1%	2.6%	3.8%
Arizona	-3.1	2.9	3.4	3.6	4.0	4.0	5.3	2.0	3.6
California	-1.5	1.7	2.1	1.7	2.4	3.7	2.9	0.7	2.4
Colorado	2.1	2.7	1.8	2.8	3.0	3.8	4.1	0.7	2.7
Hawaii	0	2.0	0.6	2.1	3.6	3.3	3.0	0.9	2.4
Idaho	1.8	3.4	2.8	1.9	2.5	3.8	3.1	2.2	2.7
Montana	1.4	3.8	2.6	0.4	3.0	2.8	2.8	1.8	2.5
Nevada	6.5	8.1	6.3	4.1	5.8	5.3	5.7	3.4	5.6
New Mexico	0	3.0	4.7	2.4	3.4	3.3	3.2	0.9	2.6
North Dakota	1.8	1.6	0.9	1.1	1.2	1.8	2.0	1.7	1.6
Oregon	-2.6	-1.5	0.6	0.7	1.1	0.6	2.1	0.3	1.0
Utah	-2.0	4.5	3.3	3.5	2.5	3.2	2.9	1.7	2.3
Washington	-2.4	-2.1	-0.4	0.6	1.9	1.5	3.3	1.1	1.3
Wyoming	1.0	2.5	0.9	4.5	2.5	2.6	4.4*	10.5*	3.4
WICHE States	0.8%	1.7%	1.9%	1.8%	2.4%	3.2%	3.0%	1.0%	2.3%
U.S. Total	0.9%	1.5%	3.5%	1.0%	1.5%	2.3%	2.9%	0.4%	1.4%

Sources: State figures compiled from data and projections provided by state employment and labor agencies. U. S. totals from Department of Labor, Bureau of Labor Statistics, Monthly Labor Review (November 1983).

Notes: Projections and average annual change based on Bureau of Labor Statistics moderate growth projection, using a base year of 1980 and projection year of 1990 except where comparable data were not available. In these cases the base year varied from 1979 (U.S. total and Oregon) to 1983 (Nevada). For four states (Hawaii, Idaho, Montana, and Utah) 1982 was used as the base year. The projection year was 1990 in all cases except Alaska (1989) and Washington (1987). Data exclude agricultural wage and salary employment and self-employed.

* Reflects some modification in sector definitions since base year.

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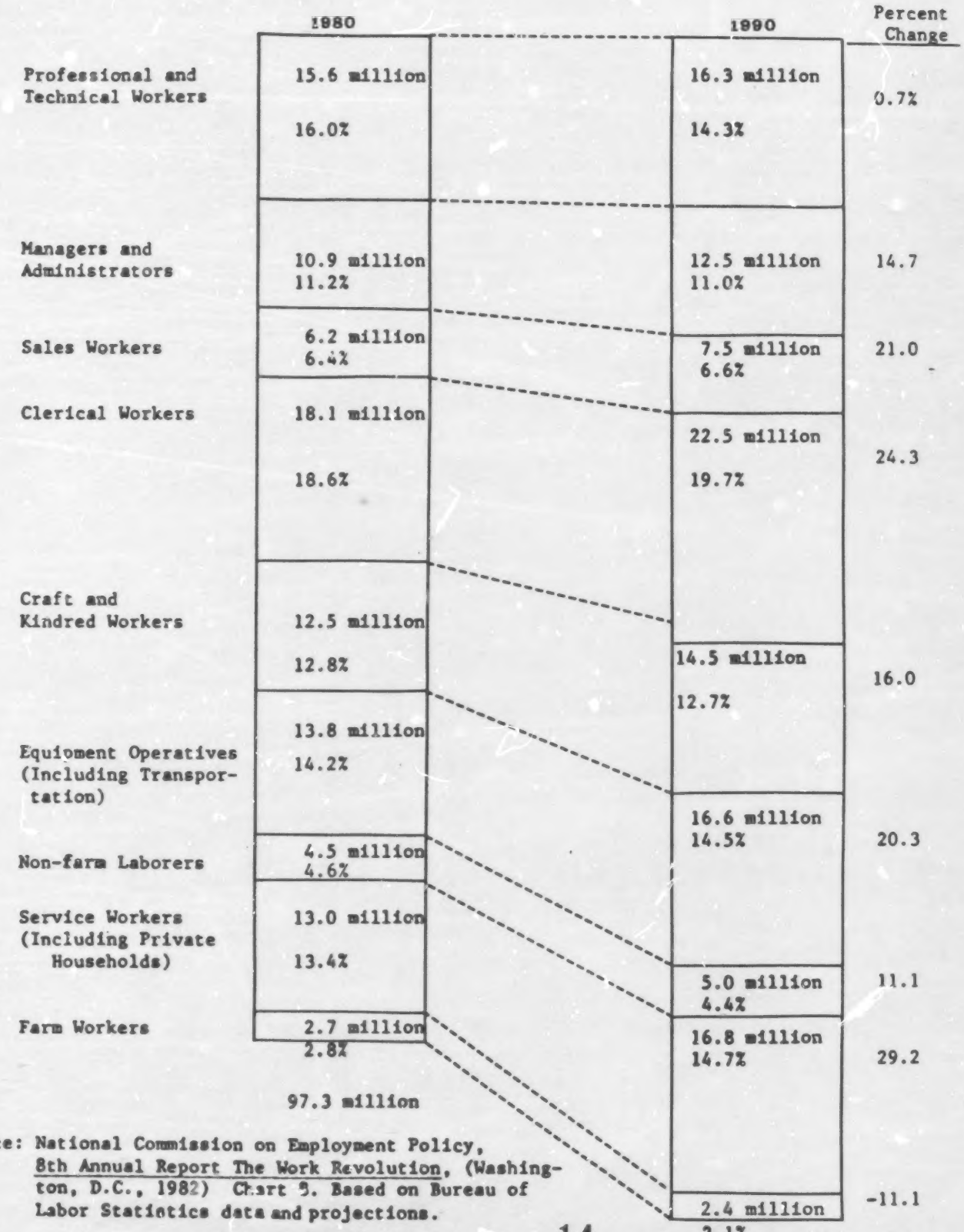
TABLE II-7

U.S. OCCUPATIONAL PROFILE--1980 AND 1990
(Number of Jobs in Millions and Percent of Total)



Source: National Commission on Employment Policy, 8th Annual Report The Work Revolution, (Washington, D.C., 1982) Chart 3. Based on Bureau of Labor Statistics data and projections.

facilities, and other factors. Overall, the variations in mining and manufacturing employment appear to indicate some of the most important characteristics of WICHE state economies.

Employment and Technological Changes

State and federal agencies periodically project changes in employment in major industrial categories based on the patterns of recent years and assumptions about national economic growth. Although subject to the uncertainties inherent in any estimating techniques, these projections indicate anticipated employment averaged over a number of years. Table II-6, based on data provided by state agencies, shows the average annual change in employment for the major industrial categories in the WICHE states. Several trends are particularly notable:

- Employment in manufacturing is expected to increase much more slowly in the WICHE states (1.9 percent per year) than in the nation as a whole (3.5 percent per year).
- In contrast, in the WICHE states employment in the sectors of transportation, communications, and utilities; trade; finance, insurance, and real estate; and government is expected to expand more rapidly than in the nation as a whole.
- Service employment is expected to expand rapidly, both regionally and nationally.
- Total employment is expected to expand by an average of 2.3 percent per year in WICHE states, compared to 1.4 percent nationally.

Projections for employment changes in specific occupational categories at the national level are presented in Table II-7. The 17.3 percent growth in total employment in these occupational categories (from 97.3 million in 1980 to 114.1 million in 1990) is based on increases in all categories except farm workers. The rate of increase in the other categories, however, varies significantly:

- The smallest increases are projected for the category of professional and technical workers, with only 0.7 percent growth (600,000 positions) between 1980 and 1990.

- The largest increases are projected for the categories of service workers (29.2 percent), clerical workers (24.3 percent), sales workers (21.0 percent), and equipment operatives (20.3 percent). By 1990, service workers and clerical workers combined are expected to increase to nearly 35 percent of total employment, with 8.2 million more jobs in these occupations than in 1980.

- Employment in the occupational categories of managers and administrators, craft and kindred workers, and non-farm laborers is expected to increase substantially, but will slightly diminish in importance in terms of the proportion of total employment by 1990.

These occupational projections do not indicate the types and extent of changes that are likely to occur within each of these categories during the 1980s. Many fields require a knowledge of new technologies or business processes. Employment in the financial industry with commercial banks, securities firms, and expanding financial service companies, for example, increasingly requires specialized training and experience in computer applications and communications. Citicorp, one of the largest such firms, estimates that technology-related employees comprise 10 percent of their workforce, and this proportion is likely to continue growing.[1]

Technical advances in communications and industry reorganization related to the breakup of the Bell System and the competition from new companies are likely to create new jobs and new skill requirements in telecommunications. The rapidly expanding consumer electronics industry also will provide new job opportunities. Much of the $30 to $40 billion per year in retail sales in video cassette recorders, digital televisions, compact disk players, and other equipment is in foreign-made products. But employment is generated in marketing and sales, and increasingly for after-sales service technicians. Employment for such technicians is growing and becoming more established as a career. Community colleges and trade schools are expanding training programs for this field, and a number of states now require certificates and proficiency tests.

The use of office and home computers is continuing to expand, creating employment opportunities in installation, software design, sales and marketing, and after-sales services. Computer usage also affects the skills and job

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[1] "High Technology Employment Outlook," New York Times, March 12, 1985, Section 12.

requirements in more traditional fields such as nursing and health care, general business, and office administration. Other, more specialized technologies are also expanding employment opportunities. For example, the demand for laser-electro-optic technicians has increased by 44 percent since 1980 and is expected to grow another 25 percent by 1990.[2] While many of these positions require a specialized engineering background, more applied technicians are also needed to repair and maintain technological equipment.

Although new technologies will have a broad and profound impact on many industries and occupations, direct employment in high-technology manufacturing and service industries will play a limited role in the overall economy and may continue to be concentrated in certain locations. Industries comprising the high-technology sector tend to span several of the conventional product categories. Generally, high-technology industries are identified by certain shared characteristics, including:

- relatively high expenditures on research and development of products,
- relatively large shares of scientific and technical personnel in total employment,
- sophisticated production and product-delivery systems, and
- rapid production changes and high product turnover.

The number of industries included depends upon how stringently these criteria are defined. Broadly applied, a significant portion of durable goods manufacturing can be included. As normally defined, however, high-technology industry includes companies engaged primarily in the design and development of new products through the application of recent scientific and technical advances.

The Bureau of Labor Statistics has developed three definitions of high-technology industries based on the above criteria. The most stringent includes only 2.5 percent of all wage and salary employment nationwide. The least restrictive includes 13 to 14 percent of total employment. Under all three definitions the contributions of high-technology industries to total employment growth through 1990 appear to be relatively small, according to the

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[2]Statistics from the Center for Occupation Research and Development, cited in "High Technology Employment Outlook," p. 51.

bureau's projections. Industries included in the most restrictive definition were projected to generate only 4.7 of total employment growth through 1990; industries under the broadest high-tech definition were projected to contribute approximately 15 percent of employment growth during the decade.[3] Moreover, this high-technology growth was highly cyclical and geographically concentrated.

The general conclusion of this and other analyses is that despite rapid growth and continued expansion, high-technology industries will generate a relative small share of total employment in the foreseeable future. Even with continued growth at higher rates than other sectors of the national economy, the overwhelming majority of new jobs will be created in other industrial sectors and in more traditional occupational categories.

The consequences of high-technology expansion, however, are broader than the direct employment opportunities. Much of the impact of high-tech development occurs through the adoption of new equipment or techniques within other industrial and business sectors. Compared to the small proportion of the labor force actually employed in high-technology industries, these downstream uses of high-technology products are likely to have a much more substantial impact on employment opportunities and job requirements.

What applies to the nation as a whole with respect to high-technology development does not apply equally to all states or regions. Table II-8 presents data on high technology industries in the WICHE states, using an aggregation of industries similar to the Bureau of Labor Statistics' intermediate high-technology definition. As is apparent from these data, many of the western states are high technology intensive compared to the nation as a whole and to other states in the West.

While limited to the specific industries included in this definition, several characteristics of high-technology industry in the nation and the region are indicated in Table II-8:

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[3]Richard W. Richie, Daniel E. Hecker, and John V. Burgan, "High Technology Today and Tomorrow: A Small Slice of the Employment Pie," Monthly Labor Review (November 1983), pp. 50-58.

TABLE II-8

HIGH TECHNOLOGY INDUSTRIES IN THE WICHE STATES

	Number of High Technology Establishments 1982	Percent of Total Business Establishments 1982	Employment in High Technology Establishments 1982	Percent of Total Employment in the State, 1982	Percent Increase in High Technology Employment 1975-1980	Percent Increase in High Technology Employment 1980-1982
Alaska	58	0.33%	243	0.19%	19.5%	80.0%
Arizona	602	1.06	87,442	10.32	113.4	9.7
California	9,146	1.74	846,209	10.16	44.4	3.9
Colorado	853	1.15	76,137	6.87	73.9	15.6
Hawaii	91	0.42	1,293	0.42	67.8	9.9
Idaho	97	0.48	4,858	2.09	93.9	-.22
Montana	77	0.37	915	0.46	49.8	19.3
Nevada	147	0.77	5,177	1.52	205.3	28.5
New Mexico	163	0.59	10,509	3.05	44.6	41.3
North Dakota	41	0.25	1,499	0.84	224.0	11.4
Oregon	546	0.91	39,940	5.23	76.1	6.1
Utah	322	1.12	29,160	6.72	84.4	9.0
Washington	825	0.91	96,359	7.77	49.1	-4.6
Wyoming	40	0.29	840	0.53	105.0	14.4
WICHE States	12,984	1.32%	1,200,581	8.23%	49.1%	4.8%
U. S. Total	47,019	1.01%	4,348,308	5.85%	29.9%	-0.46%

Sources: Staff compilation of data from U.S. Department of the Census, County Business Patterns 1975, 1980, and 1982 (Washington, D.C., 1978, 1982, and 1984).

Note: High technology industries include establishments and employment with the following Standard Industrial Classification (SIC) codes: 283 Drugs; 348 Ordinance; 357 Office Machines; 36 Electric/Electrical Equipment; 372 Aircraft; 376 Missiles; 379 Miscellaneous Transportation; 38 Measuring, Controlling, and Analyzing Equipment; 737 Computer and Data Processing Services.

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- High-tech firms are a relatively small proportion of total business establishments—1.32 percent of businesses in the WICHE states and 1.01 percent in the nation as a whole in 1982. Small, start-up firms may have been undercounted, however, because of limitations in the data.

- Employment in these high-technology industries was 8.23 percent of total employment in WICHE states, significantly higher than for the nation as a whole in 1982.

- High-technology employment varies substantially among the WICHE states, from over 10 percent in Arizona and California, 5 to 8 percent in Colorado, Oregon, Utah, and Washington, to less than 1 percent in Alaska, Hawaii, Montana, North Dakota, and Wyoming.

- Employment in these high-technology industries increased rapidly between 1975 and 1980--49.1 percent for the WICHE states and 29.9 percent for the nation as a whole. Between 1980 and 1982 high-tech employment expanded only 4.8 percent in the WICHE region, and did not expand in the nation as a whole.

Growth in high-technology industries alone will not be sufficient to assure overall economic expansion. At the same time, high-technology industries are a leading component in many local economies and in many strategies to encourage economic development. Such industries tend to be leaders in terms of using research and developing new products, employing a highly trained and specialized workforce, and developing new methods of production. These characteristics tend to have a rippling effect throughout a local or regional economy, from direct "multiplier" effects and through the emphasis on applying new knowledge and entrepreneurial business practices.

The promise of high technology as a major employer and as a component in economic expansion must be tempered by an awareness of the risks involved. Rapid changes in products, market demand, or organization can suddenly reverse the growth of employment. Colorado, for example, has experienced a series of work-force reductions in electronic equipment industries. Some 6,000 jobs were lost in late 1984 and early 1985, with little prospect that comparable job openings will be available in the immediate future. Idaho has also experienced layoffs in the electronics industries, and more are likely as a result of IBM's recent decision to discontinue one line of home computers. Without continued expansion in this small but dynamic component, Idaho's economy is essentially static. Other states such as Arizona, Nevada, and Utah depend upon expansion in high technology and related sectors to generate

employment opportunities for a rapidly expanding population. Oregon and Washington, where rapid growth during the 1970s included substantial high-technology development, now look to this sector to replace some of the employment lost in more traditional sectors of the economy.

Implications for Community Colleges

Economic change must be seen from the perspective of individuals, businesses, and localities, not just as aggregate measures of production and employment. Aggregate statistics often mask much of the change, the "churning" in the economy, as well as the diversity of conditions. Consider employment growth and unemployment. Most areas of the United States lose about 8 percent of existing jobs per year. This rate varies in relation to business cycles, but job losses continue even during economic expansion as businesses modify operations, lay off employees, or go out of business. Because of this churning in the economy, most areas must replace approximately 50 percent of their job base every five years to remain level in employment.[4]

Job turnover tends to be relatively independent of regional growth patterns. High growth areas, in fact, often have some of the highest turnover rates. Silicon Valley in California and other high technology centers in the West typically have high job turnover. It is not job losses that are unusual or correlated with economic decline. Rather, it is the ability to replace normal job losses with new employment opportunities that reflects whether or not an economy is expanding.

Viewed in this way, the role of education is central to the maintenance and expansion of local economies. Education and training often determine whether an individual will qualify for a new or different position. An educated and suitably trained workforce is an important factor in business

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[4]David L. Birch, "Job Creation in the U.S. and Other Western Nations," in U.S. Congress, House of Representatives, Joint Hearings Before the Subcommittee on Science, Research and Technology of the Committee on Science and Technology and the Task Force on Education and Employment of the Committee on Budget. Technology and Employment 98th Congress, First Session, June 1983, p.87.

decisions to expand operations or to locate in a particular area. Education is particularly important in the expansion of high-technology industry and to the expansion of high-technology products to other sectors of the economy.

The types of education and skills most suitable for future employment opportunities is a matter of much debate. Some observers point to the fact that employment opportunities in high-technology industries per se will be limited in number and skewed toward highly technical specialties. Outside of these positions they foresee the effect of new technologies to involve the downgrading of existing skills and job requirements because of the increased use of robots, computerized operations, and automation.[5] In this view, neither broad liberal arts education nor specialized vocational training may be essential.

In contrast, the Task Force on Education for Economic Growth of the Education Commission of the States concluded that:

> Technological change and global competition make it imperative to equip students . . . with skills that go beyond the 'basics.' For productive participation in a society that depends ever more heavily on technology, students will need more than minimum competence in reading, writing, mathematics, science, reasoning, the use of computers, and other areas.[6]

This position asserts that the spread of new technologies will continue to expand the demands upon education for both liberal arts and technical skills.

The effects of economic and technological changes will be felt among current employees as well as the unemployed and the young. This suggests the need to enhance through education the ability to adapt to continuing changes in the economic environment and in our personal lives. Continuing or intermittent educational opportunities need to be provided, and additional training or retraining may become necessary within many industries and occupations.

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[5]See, for example, Henry M. Levin and Russell W. Rumberger. The Educational Implications of High Technology (Stanford University, Institute for Research on Educational Finance and Governance, February 1983).

[6]Quoted in Russell W. Rumberger, The Potential Impact of Technology on the Skill Requirements of Future Jobs (Stanford University, Institute for Research on Educational Finance and Governance, November 1984).

Only through these means may individuals, localities, and society as a whole avoid what one observer has called the "growing mismatch of jobs and job seekers."[7]

In meeting these challenges, new technology itself can be used effectively by postsecondary education. Cable and broadcast television, video and audio cassettes, two-way interactive systems, and other types of telecommunications and audio-video technologies are being increasingly used to provide instruction in isolated locations, to larger audiences, and in ways that meet the needs of students and employers. Often these new educational delivery systems are more effective and less costly than traditional methods, and have a clear advantage in terms of student access and convenience. Computer-assisted instruction provides the means to individualize the learning process, to aid those with particular difficulties or deficiencies as well as those seeking highly specialized training. Computers have many other valuable applications in education as well, from on-line bibliographic systems, to sophisticated modeling simulation, to educational games. In these and other areas new technologies have the potential to make education more effective and efficient.

A recent WICHE survey of the western states shows that community colleges are at the forefront in using these new technologies. Particularly in the application of video and audio technologies, two-year institutions are ahead of four-year colleges and universities in providing new educational options to meet a variety of needs.[8] Community colleges also make extensive use of computers for educational purposes, although the high cost of equipment and software appears to be a significant limiting factor. These institutions, perhaps more than others, need to adapt these new technologies to improve educational access and effectiveness.

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[7]Peter F. Drucker, "A Growing Mismatch of Jobs and Job Seekers," The Wall Street Journal, March 26, 1985, p. 36.

[8]Raymond J. Lewis with Richard Markwood, Instructional Applications of Information Technologies in the West (Boulder, Colorado: Western Interstate Commission for Higher Education, 1985).

Increasingly in recent years community colleges have also expanded and focused activities to meet the educational needs of the rapidly changing economic environment. Often under the heading of economic development activities, institutions have combined traditional roles in providing vocational and occupational education with expanded efforts to develop linkages with local businesses and to meet new training needs in high-technology areas. These expanded economic development activities raise a number of issues about the mission and roles of community colleges, about how such expanded activities should be financed, about the relationships between students, institutions, and employers, and about the interaction between colleges, communities, and states.

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